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General Instructions

Use this procedure in conjunction with the OEC 9800 Periodic Maintenance (PM) Inspection Report form. Enter the required information at the top of the form prior to performing the PM test procedures. Read the “Safety” section. Perform the procedures in the “Preparation” section and then begin the periodic maintenance. During testing, place a check mark next to each test completed, and (where applicable) record the measured values; if adjustments to these values are made, note them on the form in the comments section.

***Note**: The **numbered** sections and their titles in this document correspond to those on the form.*

Log all test equipment used on the form in the block near the bottom, *Test Equipment Used*.

***Note**: Test equipment must have current calibration dates. Do not use test equipment with expired calibration stickers.*

Safety

Ingress Of Water And Solutions

The system must never be operated or stored in locations where conductive fluids, like water and saline solution, might spill on the equipment.

Always unplug the AC power cable from the wall outlet before cleaning the equipment. Do not allow water, soap, or other liquids to drip into the equipment and cause short circuits, electric shock and fire hazards.

Unauthorized Modifications

Under no circumstances should the safety interlock in the system be bypassed, jumpered, or otherwise disabled.

***Note**: All GE OEC systems comply with International Electrotechnical Commission safety standard IEC-60601. Do not connect any external device to the system that does not meet the requirements of IEC-60601. Only devices provided or approved by GE OEC Medical Systems, Inc. should be connected to the system.*

Motorized Mechanical Operation

The Vertical Column is motorized and should be observed continuously during operation to avoid collision with people and equipment.

If covers are removed, use extreme care when operating motorized features. Do not wear loose clothing that may be caught by mechanical mechanisms. Keep hands and fingers clear of motorized equipment while the motors are in operation.

Trained Service Personnel

Serious injury and property damage can result from incorrectly performed service procedures. Observe all operating and safety procedures discussed in this document.

***WARNING**: Procedures should be performed by service personnel specifically trained by GE OEC Medical Systems, Inc. to calibrate the OEC 9800 C-Arm and Workstation.*

Electrical Shock

***WARNING**: This system can generate lethal voltages. Practice safe electrical testing procedures when performing periodic maintenance procedures.*

WARNING: *After taking X-rays, the high voltage cables can retain a lethal charge, even if you power down the system. Even though the contacts are recessed, high voltages can arc several inches from their terminals if the cables are removed from the connector wells. Use caution when disconnecting high voltage cables even when the power is turned* ***off****. If you remove these connections, immediately discharge their contacts against the high voltage tank case (ground).*

WARNING: *Use caution when working near the batteries and their connections. Remove metal rings and watchbands that may inadvertently come in contact with the battery terminals. Severe skin burns could result if such metal articles were shorted across the battery terminals.*

X-radiation Exposure

The X-ray tube assembly produces X-radiation when energized. Never operate this device without X-ray shielding in place. Use lead shielding and draping to protect personnel.

WARNING: *Lead aprons, radiation monitors, and appropriate radiation shields must be utilized for the protection of all personnel in the vicinity while performing tests. Living human anatomy should never be used as a phantom or demonstration aid. Do not produce radiation in hallways.*

CAUTION: *Many of the PCB's in this system contain components which are sensitive to Electro-Static Discharge (ESD). Observe ESD safety procedures.*

Required Tools, Test Equipment, and Specifications

Tools

In addition to common hand tools, the following tools are required:

- Torx Screwdriver Set
- Spline Driver, .048, P/N 00-900920-01

Test Equipment

- Oscilloscope Tektronix 2236 or equivalent
- Digital Volt-Ohm-Meter
- Dosimeter (Keithley Model 35050, PMX II non-invasive meter or equivalent)
- C-Arm Extender Card, P/N 00-879248-01
- Ion Chamber
- Bore Sight Tool, P/N 00-879599-01
- Resolution Tool
- Probe Holding Fixture
- Lead Apron
- 1 mm Copper Filter (3 each required), P/N 00-877682-01
- 9800 Boot and Diagnostic Disk (software), P/N 00-876781-01
- 9″ Beam Alignment Tool, P/N 00-878105-01

- 12″ Beam Alignment Tool, P/N 00-878867-01
- kVp meter
- Lead Blocker (P/N 00-900041-01)

Paint Kits

Part Number	Description
900524-11	Paint Kit, Elite Gray, Texture
900524-12	Paint Kit, Rhinestone, Texture
900524-13	Paint Kit, Windswept, Texture

Miscellaneous

- Alcohol Prep Pads

The PM Form

PM Form Information

The 9800 Periodic Maintenance Form has been designed using the Microsoft® Word 97 form tool and should be completed on-line. The on-line form contains three types of information fields: text/number fields, checkboxes and pull-down menus.

You can navigate the form using the tab key or by using your mouse. We recommend that you use the mouse. The steps should be completed in a vertical order. The tab key tabs horizontally.

For text fields type in the requested information, such as hospital name, etc. For checkboxes, place the mouse cursor on the checkbox and click. This will place an X in the checkbox. For pull-down menus choose the appropriate selection when they are displayed and verify that it is present when you close the field.

To make the on-line PM Form template available to MS Word save the template in the Microsoft Office Template directory.

Beginning the PM Form

1. Enter the Serial Number in the text field.
2. Enter the Start Date in the text field.
3. Read the elapsed time meter on the Workstation and enter the number on the PM Form.
4. Select whether the PM is semi-annual or annual from the pull-down menu.
5. Complete the customer information: Customer Name, Address, etc.
6. Record the equipment type on the PM Inspection Form.
7. Record the equipment model numbers on the PM Inspection Form.
8. Record the equipment serial numbers on the PM Inspection Form.

9. Record the equipment calibration due date on the PM Inspection Form.

Remove Power and Covers

WARNING: *Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.*

1. If the system has power applied, place the Workstation power switch in the **OFF** position and unplug the Workstation's AC power cord from the wall outlet.
2. Remove the Workstation rear cover, left side cover, and open the electronic card rack rear door.

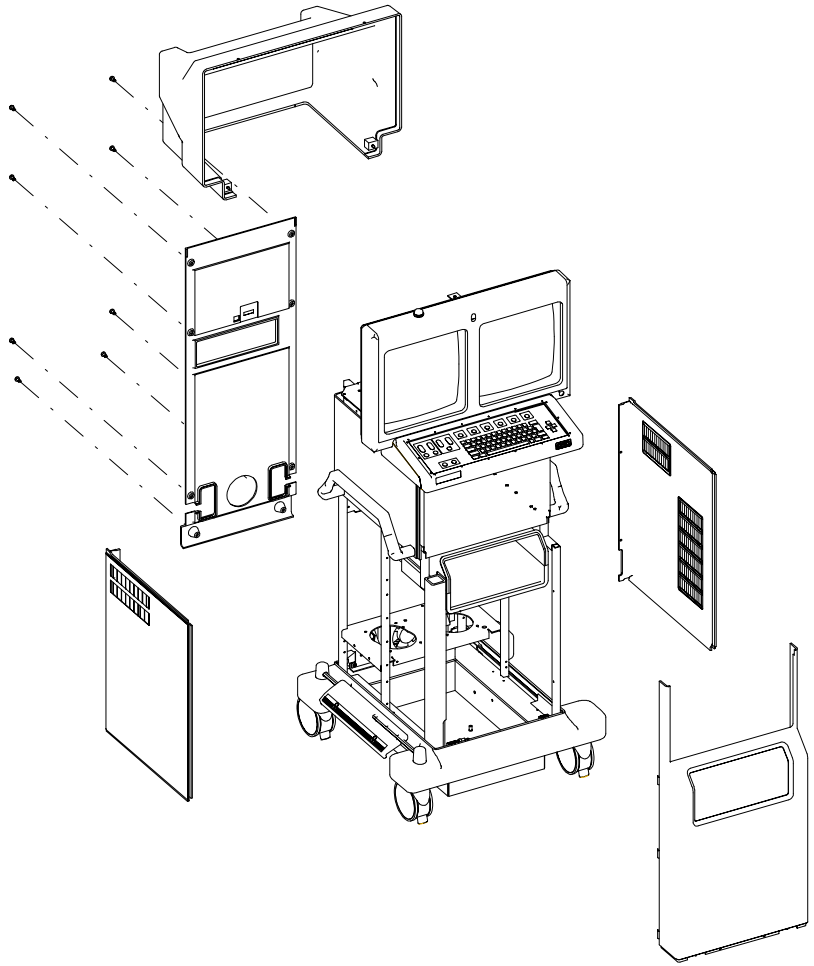

Figure 1. Removing the Workstation Covers

3. Remove the C-Arm's front cover first and then the right cover and left cover.
4. Remove the screws from the C-Arm's rear cover and then loosen the 2 upper set screws on the steering shafts' compression coupler so the upper shaft is disconnected from the lower shaft and the rear cover can be removed freely. Remove the rear cover.

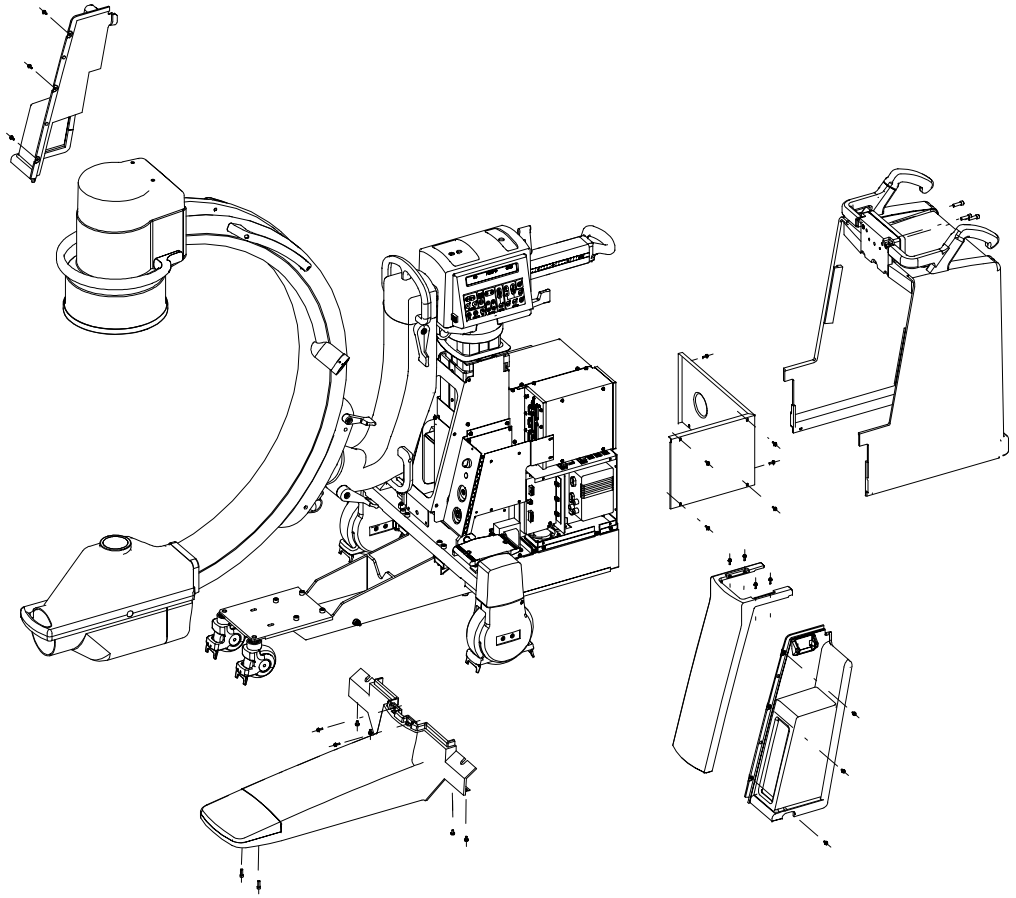

Figure 2. Remove the C-Arm Covers and Disconnecting Steering Linkage

Safety Inspections

When performing a semi-annual PM perform the *Safety Inspections* section, *Power Supplies and Battery Inspections* section, *Functional Inspection* section, and *Completing the PM* section.

When performing an annual PM perform all sections.

Mechanical Inspections

Brakes

1. Engage the Wig-Wag brake and verify that the brake prevents Wig-Wag movement.
2. Tighten the Flip Flop brake and verify that the Flip Flop does not move.
3. Engage the C-Arm Orbital brake and verify that the C-Arm does not move.
4. Engage the Horizontal Cross-Arm brake and verify that the Cross-Arm does not move.
5. Engage the L-Arm brake and verify that the L-Arm does not move.
6. Engage the C-Arm wheel brake and then attempt to push the C-Arm. The wheels should not roll.
7. Engage the Workstation's wheel brake and then push the Workstation and verify that the caster/wheel assemblies are locked in position and do not move.

Wheels/Casters

1. Push the C-Arm and verify that the wheels roll smoothly, the casters turn freely and that the wheels are securely attached to the casters. Visually inspect the wheels for damage.
2. Push the Workstation and verify that the wheels roll smoothly without vibration and that they are securely attached to the casters. Visually inspect the wheels for damage.
3. Verify that the cable pusher blades have not been damaged.

Non-Motorized Movements

Wig Wag

1. Release the Wig-Wag brake and verify that the forward mechanics move laterally **approximately** ± 10° (20° total).

Flip Flop Rotation (Standard C-Arms only)

1. Release the Flip Flop brake and verify that the C-arm "flip-flops" through its entire range smoothly without roughness or vibration.

Radial Rotation

Perform the following to verify radial rotation on Standard C-Arms and Super C-Arms:

1. On a standard C-Arm release the L-Arm brake and verify smooth rotation without roughness or vibration.
2. On a Super C-Arm release the radial brake and verify smooth rotation without roughness or vibration.

Orbital Rotation a.k.a. C-arm rotation

Perform the following to verify orbital rotation for standard C-arms and Super C-arms:

1. On Standard C-arms, release the L-Arm brake and check C-arm rotation in the following positions:
   a. Position the C-arm parallel with the floor and lock the L-Arm brake. Rotate the C-arm through its entire range. The C-arm should rotate smoothly without vibration.
   b. Position the C-arm on the opposite side and lock the L-Arm brake. Rotate the C-arm through its entire range. The C-arm should rotate smoothly without vibration.
   c. Position the C-arm vertical to the floor, lock the L-Arm brake and rotate the C-arm through its entire range. The C-arm should rotate smoothly without vibration.
2. On Super C-arms, release the Flip Flop brake and check C-arm rotation in the following positions.
   a. Position the C-arm parallel with the floor and lock the Flip-Flop brake. Rotate the C-arm through its entire range. The C-arm should rotate smoothly without vibration.
   b. Position the C-arm on the opposite side and lock the Flip-Flop brake. Rotate the C-arm through its entire range. The C-arm should rotate smoothly without vibration.
   c. Position the C-arm vertical to the floor, lock the Flip-Flop brake and rotate the C-arm through its entire range. The C-arm should rotate smoothly without vibration.

Horizontal Cross-Arm

1. Release the horizontal Cross-Arm brake and extend and retract the cross-arm. Verify that the cross-arm slides smoothly through the housing without binding.

Inspect Static Drag Wire

1. Verify the drag wires underneath the C-Arm and the Workstation are securely attached, are touching the floor and are free of dirt and debris.

FluoroTrak™ Articulating-Arm (Option)

1. Verify that the articulating-arm mechanics move freely and smoothly throughout the entire range of motion. Adjust the articulating arm's friction brake if necessary.
2. Verify that the articulating-arm mechanics have negligible mechanical drift. Adjust the friction brake and/or mechanical assemblies if necessary.

Electrical Inspections

Electrical Plug/Power Cord

1. Inspect the Workstation's AC power cable for damage and wear. Verify the presence of the AC ground pin.

Interconnect Cable And Pins

1. Inspect the interconnect cable; verify that the cable, C-Arm connector, and pins are not damaged. Verify the LEMO connector strain relief is tightened securely.

Ground Continuity

WARNING: *Do not perform this continuity test with the AC plug plugged into a power receptacle.*

1. Verify continuity between the following:

From	To	Spec
Interconnect Cable J1-3 (Safety GND)	AC Power Plug Ground Pin	< 0.5 Ω
Interconnect Cable Shield (Metal Casing)	AC Power Plug Ground Pin	< 0.5 Ω
AC Power Plug Ground Pin	Interconnect J1-9	< 0.5 Ω
AC Power Plug Ground Pin	Interconnect J1-15	< 0.5 Ω

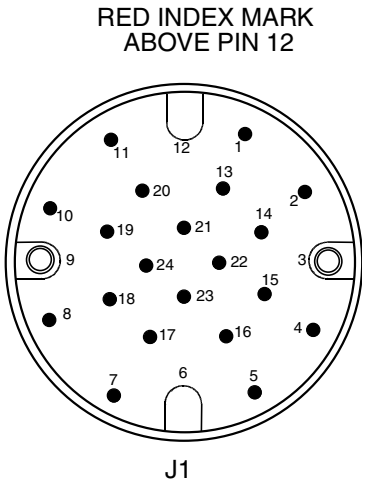

Figure 3. J1 Interconnect Cable Pin-out

3. Connect the Interconnect Cable to the C-Arm and verify continuity between the following:

From	To	Spec
C-Arm Second Earth Ground (Bottom left beneath Front Leg Cover)	AC Power Plug Ground Pin	< 0.5 Ω
Workstation Equipotentiality Stud (Underneath the bottom right side)	AC Power Plug Ground Pin	< 0.5 Ω

4. Record only the highest resistance on the PM form.

Power Supplies & Battery Inspections

Power ON

WARNING: *Observe safety procedures when operating motorized features.*

1. Plug the AC power cord into the wall receptacle.
2. Turn the C-Arm keyswitch to the on position, fully clockwise.
3. Press the power switch located on the Workstation.

Incoming Line Regulation

Line Regulation

1. If the system is equipped with a 100-127 VAC power cord, measure the voltage from the BRN wire to WHT/BLU on T1 primary.

   If the system is equipped with a 200-250 VAC power cord, measure the voltage from the BRN wire to BLU on the T1 primary.

2. Verify the transformer is strapped correctly; according to the following tables. Table 1 for voltage sources ranging from 100-127 VAC and Table 2 for voltage sources ranging from 200-250 VAC.

Table 1 (100 – 127 VAC)				
If the primary of T1 voltage measures between	The WHT/BLU wire should be connected to Primary #1	The BRN wire should be connected to Primary #1	The BLU wire should be connected to Primary #2	The WHT/BRN wire should be
104.0 to 109.9	6	113	6	113
110.0 to 115.9	0	113	0	113
116.0 to 121.9	6	125	6	125
122.0 to 128.0	0	125	0	125

Table 2 (200 – 250 VAC)				
If the primary of T1 voltage measures between …	The WHT/BLU wire should be connected to Primary #1	The BRN wire should be connected to Primary #1	The BLU wire should be connected to Primary #2	The WHT/BRN wire should be connected
196.0 to 207.9	0	101	0	101
208.0 to 219.9	6	113	6	113
220.0 to 231.9	0	113	0	113
232.0 to243.9	6	125	6	125
244.0 to 256.0	0	125	0	125

***Note**: In the next step, the voltage measured at the wall receptacle will drop immediately after the exposure is started. Read the meter at this time.*

3. Measure the AC line voltage (Voltage No Load = Vn) at the wall receptacle where the equipment is used.

4. Measure the line voltage at the wall receptacle again (voltage loaded = Vl) while making a radiographic exposure (300 mAs @ 100 kVp).
5. Calculate the percentage line voltage regulation using the following formula and record the results on the PM Inspection Report form:

$$100 \times \frac{Vn - Vl}{Vl} =$$

6. If the results above do not fall within the range of 0 - 15 %, inform the hospital administration that they will need to correct this problem. (This problem results in a violation of a provision of the Federal Performance Standards 21 CFR 1020.30)

Isolation Transformer, Secondary Output

1. Measure the AC voltage on the isolation transformer's secondary output from AC1 to AC2 and record the measured value on the PM Inspection Report form.
2. Measure the AC voltage on the isolation transformer's secondary output from AC to RTN and record the measured value on the PM Inspection Report form.

DC Power Supplies

WARNING: *Electrical circuits inside the equipment use voltages that are capable of causing serious injury or death from electrical shock. Use appropriate precautions.*

Workstation

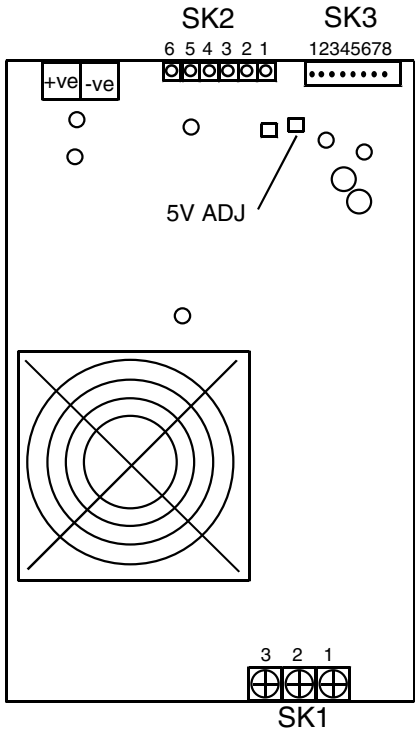

Figure 4. Location of PS1 - 5V Adjustment

System Power Supply (PS1) and Fan

1. On the DC Distribution PCB (P/N 879119) verify the following voltages:

GND	to	Adjust	VDC	Tolerance
TP1	TP2	PS1 +5v	+5.1	± 0.1
TP1	TP3		+3.3	± 0.1
TP1	TP4		+12	± 0.4
TP1	TP5		-12	± 0.4

2. Verify that the LEDs on the DC Distribution PCB are ON.

LED	Voltage	Location
DS1	+ 3.3	DC Distribution PCB Regulator
DS2	- 12.0	DC Distribution PCB Input Power
DS3	+12.0	DC Distribution PCB Input Power
DS4	+5.0	DC Distribution PCB Input Power
DS5	+5.0	Video Control PCB
DS6	+3.3	Video Control PCB
DS7	+5.0	Image Processing PCB
DS8	+3.3	Image Processing PCB
DS9	OFF	Spare

DS10	+5.0	Display Controller PCB
DS11	+3.3	Display Controller PCB
DS12	+3.3	CINE Bridge PCB
DS13	+5.0	CINE Bridge PCB
DS14	+5.0	Control Panel Processor
DS15	+12.0	Control Panel Processor

3. On the Image Processor PCB (P/N 879018) verify the following voltages and record the values on the PM Form:

GND	**to**	**Adjust**	**VDC**	**Tolerance**
TP14, BLK	TP1, RED	PS1	+5.0	± 0.05
TP14	TP2 ORN		+3.3	± 0.1

4. Measure the AC power on the power strip (TB4) located below the monitors and record the values on the PM Form:

From	to	VAC	Tolerance
TB4-5	TB4-3	115	± 5.0
TB4-5	TB4-9	115	± 5.0
TB4-5	E3	< 80[1]	N/A
TB4-3	TB4-9	230	± 10.0

Cine Enclosure Option

1. If the CINE 4 Disk Enclosure is installed remove the enclosure cover and measure the power supply test points on the backplane (without hinging the drives down). Record the values on the PM Form.

From	to	Adjust	VDC	Tolerance
TP7	TP3 RED	PS1 - +5V	+ 5.0	± 0.15
TP7	TP5 YEL		+12.0	± 0.6

***Note**: If the CINE 2 disk is installed, you have already measured the supply voltage at PS1.*

[1] Floating neutral voltage is dependant on attached accessories.

C-ARM POWER SUPPLIES

PS1 (located behind power panel)

1. Remove the screw holding the power panel door in place and swing the door open on its hinge. Verify the following voltages on connector J2 and record the values on the PM Form:

GND	to	Adjust	VDC	Tolerance
J2-5	J2-1	R51[2]	+5.2	± 0.05
J2-5	J2-8	N/A	+12.0	+ 1.2 / -0.6
J2-12	J2-13	N/A	+15.0	± 0.3
J2-12	J2-11	N/A	-15.0	± 0.45

[2] Blue potentiometer with white center

PS2

1. Measure the voltages on the following power supply test points and record the values on the PM Form:

   ***Note**: The voltage designations on the Power Supply PCB are incorrect. Adjust the voltages to the value described in the following table.*

GND	to	Adjust	VDC	Tolerance
TP1	TP6	R7	-6.10	± 0.02
TP1	TP5	R31	+6.25	± 0.02
TP1	TP4	N/A	+14.0	± 1.0
TP1	TP3	R30	+24.1	± 0.02
TP1	TP2	N/A	-14.0	± 1.0

Generator Batteries

This procedure can be used to verify that a fully charged set of battery packs is performing adequately.

WARNING *The following steps produce X-rays. Use appropriate precautions.*

1. In **FILM** mode, set the technique for 75 kVp @ 200 mAs.
2. Make an exposure and verify that the Voltage Bargraph LED located on the Battery Charger PCB indicates ≥ 160 Volts.
3. If the bargraph voltage indicates < 160 Volts verify that the voltage bargraph LED is functioning by measuring across the battery terminal with a DMM while making an exposure. If the batteries measure less than 160 Volts troubleshoot for weak battery packs or a fault on the Battery Charger PCB.

Fan Operation and Filter Cleaning

Verify the fans in the Workstation and C-Arm are operating correctly and that all air filters are clean and unobstructed.

Note: *Place a check in the check box to indicate that you checked whether the option is present or not. Select N/A in the drop down menu box, if the option is not present or select Completed in the drop down menu box to indicate that the option is installed and the work was completed.*

Workstation Fans and Air Filters

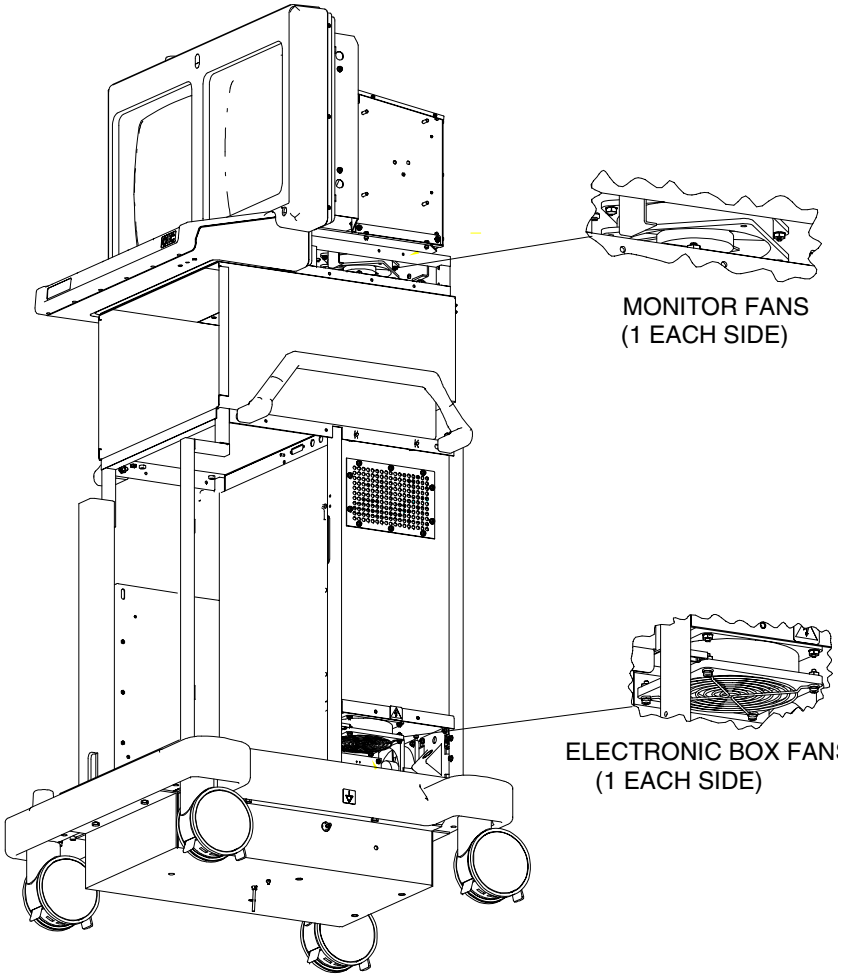

Figure 5. Location of Workstation Fans and Air Filters

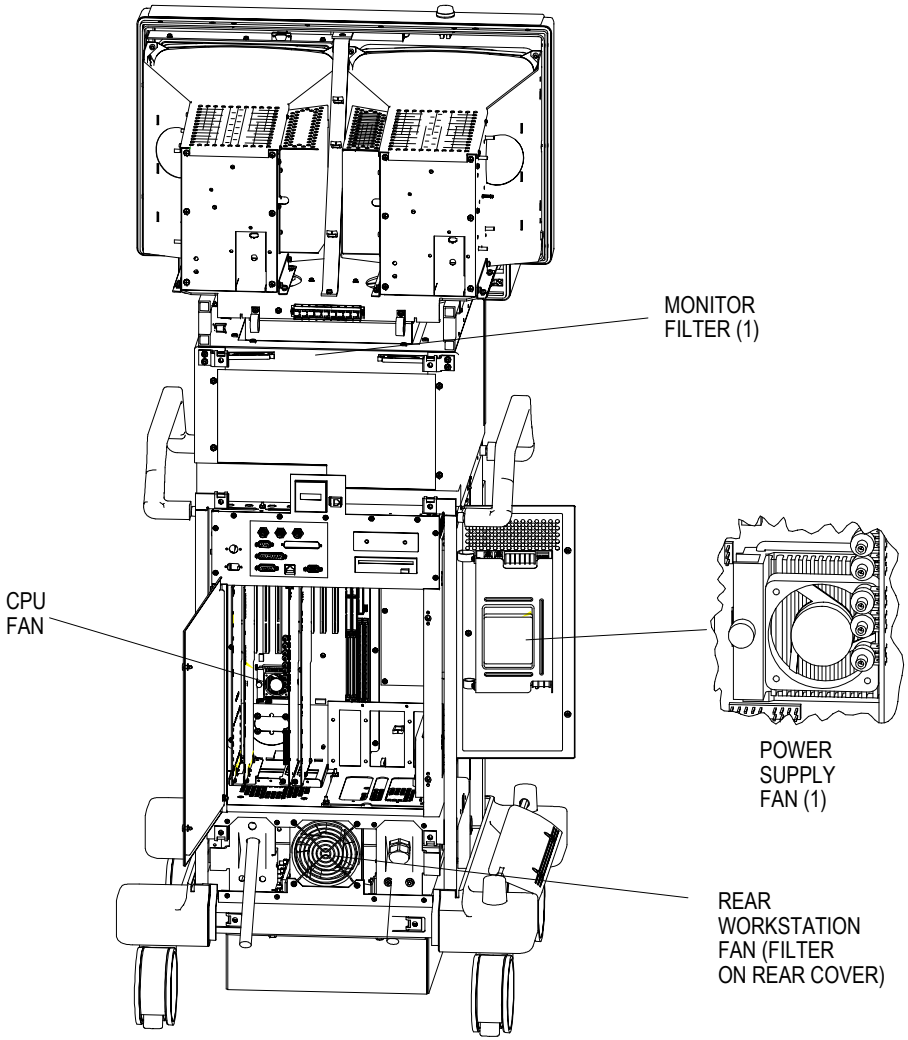

Figure 6. Location of Workstation Fans and Air Filters

Back Panel Fan and Filter

1. Verify that the main inlet fan is operational and that air flow is directed into the Workstation.
2. Inspect the main inlet fan air filter attached to the rear cover. Remove and clean if necessary.
3. Reattach the air filter to the back panel.

Monitor Fans and Filter

1. Verify both monitor fans are operational and that air flow is directed towards the monitors.
2. The rectangular air filters are retained by brackets on both sides of the Workstation. Remove the brackets first, then remove the air filters and clean the filters.
3. Insert the air filters and reinstall the retaining brackets.

System Power Supply (PS1) Fan

1. Verify that the fan on PS1 is operational.

Cine Enclosure Power Supply and Hard-drive Fans (Option)

1. Remove the cine enclosure cover and using a flashlight verify visually that the fan on the power supply is operational. Note that if the fan blades are spinning they are not visible. If the fan is not working the fan blades will be visible.
2. Verify that both AC fans cooling the hard-drives are operational.

Lower Side Panel Exhaust Filters

1. Verify that the exhaust vents on the Workstation lower side panels are unobstructed.

C-Arm Fans and Air filters

The C-Arm has fans in the following locations

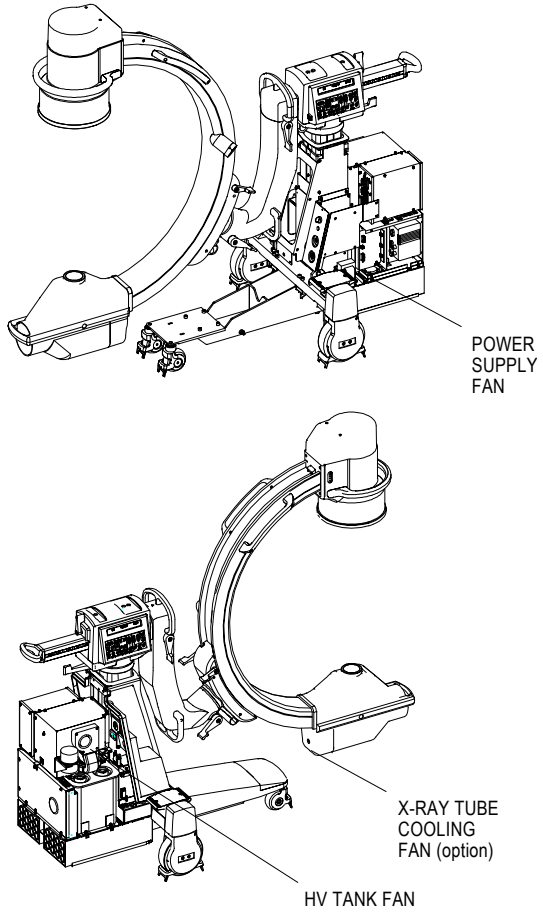

Figure 7. Location of C-Arm Fans and Filters

Multi-Power Power Supply Fan

1. Verify that the fan that cools the power supply is operating.

HV Generator Fan

1. Verify that the fan that cools the High Voltage (HV) Generator Tank is operating.

X-Ray Tube Cooling Fan (option)

This procedure is applicable only if the system has been equipped with an X-ray Tube Cooling Kit.

1. Switch **off** the Workstation power switch (if not already switched off), then remove the HV cable cover from the X-ray tube (if not already removed). You may want to disconnect the fan wires for easier access to the inside of the cover.

Note: *For the Super-C, remove the 4 mtg. screws from each vent insert (bottom and side insert), then remove the inserts to access the filters.*

2. Note the two air filters for Std. C and Super-C, inside the cover attached over the air vents. Clean each filter and make sure they are free of dust, lint or any substance which would inhibit air flow.
3. Reconnect the 2 fan wires (if disconnected) and note their color code (black to black, red to red), then reattach the HV cable cover to the X-ray tube.

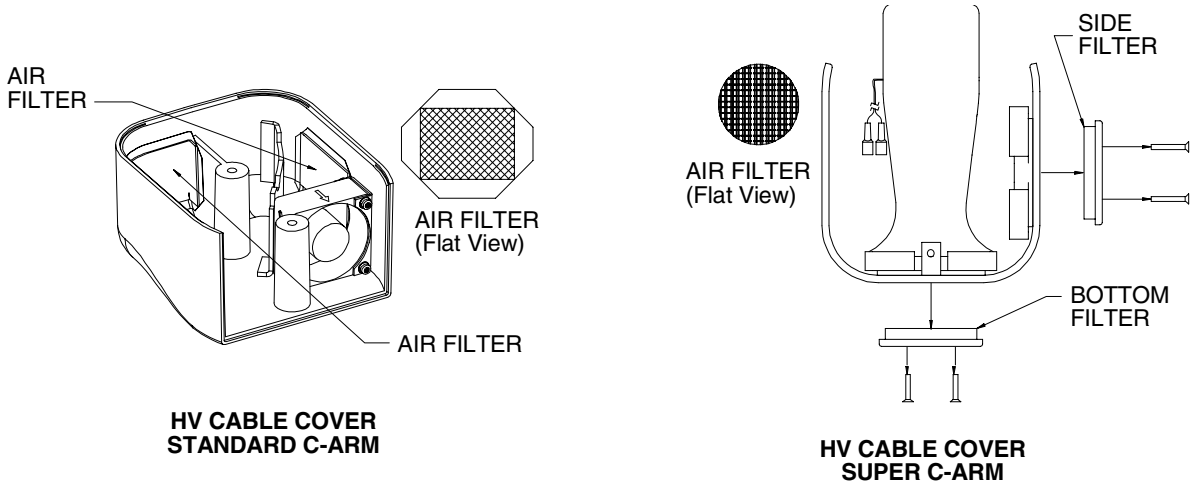

Figure 8. HV Cable Cover Filters for Standard C-Arm & Super C-Arm

Functional Inspection

C-Arm Controls

WARNING: *Some of the following procedures produces X-rays. Take appropriate precautions.*

1. Press the X-ray on switch and verify the following Image Orientation functions:
   a. Image rotation key rotates the image clockwise and counter-clockwise.
   b. Image Invert key inverts and reinverts the image.
2. Press the field size key to change the field size: NORM, MAG1 and MAG2.
3. Using the Converging Line pairs/millimeter (lp/mm) tool on the Image Intensifier, verify the resolution in lp/mm is equal to, or greater than, the values listed below:

9″ II / 60HZ	9″ II / 50HZ	12″ II / 60HZ	12″ II / 50HZ
NORM ≥ 2.3	NORM ≥ 2.3	NORM ≥ 1.7	NORM ≥ 1.7
MAG1 ≥ 3.2	MAG1 ≥ 3.2	MAG1 ≥ 2.3	MAG1 ≥ 2.3
MAG2 ≥ 3.8	MAG2 ≥ 3.8	MAG2 ≥ 3.0	MAG2 ≥ 3.0

4. Press the SAVE key to save the left monitor image to the Workstation hard-drive.
5. Press the SWAP key and verify the image on the left monitor shifts to the right monitor.
6. Press each of the following collimator switches and verify that the graphical icon indicates the correct collimator function:

***Note**: If your C-Arm's collimator is equipped with one leaf then the graphical icon displayed on the Workstation monitor will be a single line.*

a. Press the COLLIMATOR IRIS OPEN/CLOSE switch and verify that a graphical icon (circle) displays on the Workstation monitor and that the size of the circle varies as the iris is opened and closed. Press an X-ray switch and verify that the image has been collimated as portrayed by the graphical icon.

b. Press the COLLIMATOR LEAF OPEN/CLOSE switch and verify that a graphical icon (two lines) displays on the Workstation monitor and that the distance between the two lines increases and decreases as the leaves are opened and closed. Press an X-ray switch and verify that the image has been collimated as portrayed by the graphical icon.

c. Press the COLLIMATOR LEAF ROTATE switch and verify that a graphical icon (two lines) displays on the Workstation monitor and that the icon rotates as the collimator leaves are rotated. Press an X-ray switch and verify that the image has been collimated as portrayed by the graphical icon.

8. Press the MANUAL CONTRAST/BRIGHTNESS key and verify that you can increment and decrement through a series of preset levels of contrast and brightness.
9. Press the AUTO CONTRAST/BRIGHTNESS key and verify that the system automatically selects the optimum amount of contrast and brightness.
10. Press the kVp and mA keys and verify that the technique can be adjusted manually.
11. Select Auto Fluoro mode and the NORM field size. Verify that the kVp tracks accurately as copper filters are inserted into the field per the following ranges (9-inch or 12-inch II):

Copper Filters	kVp Range
1 copper filter	61 kVp ± 3 kVp
2 copper filters	71 kVp ± 3 kVp
3 copper filters	79 kVp ± 3 kVp

12. Select High Level Fluoro (HLF) mode via the Workstation Mode screen.

a. Cover the II with the lead blocker (P/N 00-900041-01) and press the right Foot/handswitch.

b. Verify that the audible tone beeps at twice the normal rate.

c. Verify that the mA is driven higher than the Fluoro limit of 5 mA.

13. Select PULSE mode via the C-Arm Control Panel.

a. Select a pulse rate of 4 Pulses Per Second (PPS) via the Workstation Mode screen and press the right foot/handswitch.

b. Verify that the audible tone beeps at twice the normal rate and the X-ray indicator flashes.

c. Select a pulse rate of 8 PPS via the Workstation Mode screen and press the right foot/handswitch.

d. Verify that the X-ray indicator flashes at approximately twice the rate as the previous step.

e. Verify that the mA is driven higher than the Fluoro limit of 5 mA.

14. Select DIGITAL SPOT via the Workstation Mode screen.

a. Press the right hand/foot switch.

b. Verify that a short-term HLF exposure is taken and automatically saved to the Workstation hard-drive.

c. Remove the lead blocker (P/N 00-900041-01) from the II.

15. Press the MODE switch located on the C-Arm Control Panel, and foot/hand switch.

a. On vascular systems verify the system toggles between standard fluoro mode and vascular imaging mode. On ESP systems verify a dumb beep.

b. On vascular systems, with vascular imaging mode selected, verify ROADMAP mode masks out image and leaves a white trace of any object that is moved in the field.

c. On vascular systems, with vascular imaging mode selected, verify SUBTRACTION mode masks out image and leaves gray background.

16. Low Dose mode operation:
    a. Press the Low Dose key. The corresponding LED will illuminate when Low Dose mode is selected.
    b. Press the Low Dose key again to deselect Low Dose mode. The corresponding LED will extinguish.
17. Press and hold the ALARM RESET key for approximately 2 seconds. Verify the Fluoro time displayed on the C-Arm Control Panel is reset to zero.
18. Select FILM mode and:
    a. Take a 120 kVp 100 mAs shot and verify that three beeps are heard after the exposure and no errors are displayed.
    b. Take a 100 kVp 300 mAs shot and verify that three beeps are heard after the exposure and no errors are displayed.

Workstation Controls

WARNING: *Steps within this procedure produce X-rays. Take appropriate precautions.*

Note: *Place a check in the check box to indicate that you checked whether the option is present or not. Select N/A in the drop down menu box, if the option is not present or select Completed in the drop down menu box to indicate that the option is installed and the work was completed.*

Keyboard Controls

1. Verify the EDGE ENHANCEMENT function displays an indicator bar and that the amount of edge enhancement can be increased and decreased.
2. Verify the NOISE FILTER function displays an indicator bar and that the amount of filtering can be increased and decreased. The noise in the image should decrease as noise filtering is increased.

3. Verify the ZOOM function displays a square box known as the Region Of Interest (ROI) and that you can magnify the ROI by touching the 2X and 4X buttons.
4. Verify the NEGATE function reverses the light and dark values on the image displayed on the left monitor.
5. Verify the CONTRAST function displays an indicator bar and that the amount of contrast can be increased and decreased.
6. Verify the BRIGHTNESS function displays an indicator bar and that the amount of brightness can be increased and decreased.
7. Verify the AUTO CONTRAST/BRIGHTNESS automatically selects the optimum values of contrast and brightness.
8. Verify the SWAP function exchanges images from the left and right monitors.
9. Verify the SAVE function saves the image on the left monitor to the Workstation's hard drive.
10. Verify the PATIENT INFORMATION function activates the Patient Information screen. Enter patient information and display saved exams screen.
11. Verify the IMAGE DIRECTORY function allows you to review, print, and archive stored images and dose information.
12. Verify the IMAGE ANNOTATION function allows you to place markers, add comments and crop images.
13. Verify the SPECIAL APPLICATIONS function allows access to Special Applications, if available.
14. Verify the CUSTOMIZE function allows access to the Customize screen.

Options

Cine Archive Disk Test

1. Verify that a cine run can be recorded to the hard disk.
2. Verify the recorded run can be played back.

High Capacity Disk Test

1. Using the Image Directory verify that dynamic and static image(s) can be saved to disk.

VCR Test

1. Verify the VCR RECORD function.
2. Verify the VCR PLAY function.

IR Transmitter test

1. Press the Remote Control Screen key and verify that the remote control screen displays on the monitor.
2. Use the cursor control to move the cursor to an executable button and press the ENTER key.
3. Press the EXIT key to exit.

Digital Hardcopy Camera test

1. Verify operation of the digital hardcopy camera. Refer to the Operator Manual Supplement.

Instant Film/Paper Printer

1. Verify that an image can be printed to the Instant Film/Paper Printer. Refer to the Operator Manual Supplement.

Thermal Printer Test

1. Verify an image can be printed to the thermal printer.

DICOM

1. Make electrical connections. Refer to the Operator Manual Supplement if necessary.
2. Verify images can be archived and printed via the DICOM interface.
3. Verify that scheduled exams can be downloaded via the DICOM interface.

FluoroTrak

1. Verify that the FluoroTrak option booted successfully and no errors messages are displayed.

Radiographic Beam Alignment Test

Film Exposure

The Radiographic Beam Alignment Test requires the exposure and development of a film. Record all measurements taken in this procedure on the PM Form.

WARNING: *The following steps produce X-rays. Use appropriate safety precautions.*

1. To nominalize C-Arm flexure, release the C-Arm brake and position the C-Arm at 45°.
2. Attach the Beam Alignment Tool on the Image Intensifier.
3. Load a film cassette in the Beam Alignment Tool.
4. Make the following four exposures on one sheet of film:
5. Select **Manual - Fluoro, Normal field** and then **Film** mode. Take a 55 KVp @ 1.5 mAs exposure.
6. Select **Manual - Fluoro, MAG 1 field** and then **Film** mode**.** Take a 55 KVp @ 1.5 mAs exposure.
7. Select **Manual - Fluoro, MAG 2 field** and then **Film** mode. Take a 55 KVp @ 1.5 mAs exposure.
8. Select **Manual** - **Fluoro** and completely close the collimator iris. Select **Film mode**. Take a 55 KVp @ 1.5 mAs exposure.
9. Remove the film cassette and develop the film.

50 mm x 50 mm Field Verification

1. Verify the 50 mm x 50 mm exposure is within the 50 mm square in the middle of the beam alignment tool. If a stop sign pattern is displayed, measure the image from the center of the flats.
2. Place a check mark in the PM Form checkbox if it passes.

Centering

Using the film and a ruler, verify the center of the image is centered on the sheet of film (X_{offset} + Y_{offset} = Sum. Record the values measured and calculated on the PM Form. Verify that the Sum is < 16 mm (13/16”) or 2% SID.

Normal Field Verification

Record the values measured and calculated for each of the following steps, on the PM Form.

1. Using the film, measure the Normal field exposure X and Y (X_{Film} and Y_{Film}) diameters and record them in the measurement table found at the end of the Beam Alignment Test.
2. Make a Normal mode Fluoro exposure. Using the scale on the beam alignment tool, measure the X and Y diameters (X_{Fluoro} and Y_{Fluoro}) displayed within the digital mask on the Workstation.
3. Calculate the absolute value of the difference between the film and Workstation X axis values ($X_{Film} – X_{Fluoro} = X_{Diff}$). Verify that the difference recorded is less than 28 mm (3% SID).
4. Calculate the absolute value of the difference between the film and Workstation Y axis values ($Y_{Film} – Y_{Fluoro} = Y_{Diff}$.). Verify that the difference recorded is less than 28 mm (3% SID).
5. Calculate the sum of the values in Steps 3 and 4 (X_{Diff} + Y_{Diff} = Sum). Verify that the sum is less than or equal to 36 mm (4% SID).

MAG1 Field Verification

Record the values measured and calculated for each of the following steps, on the PM Form.

1. Using the film, measure the Normal field exposure X and Y (X_{Film} and Y_{Film}) diameters and record them in the measurement table found at the end of the Beam Alignment Test.
2. Make a Normal mode Fluoro exposure. Using the scale on the beam alignment tool, measure the X and Y diameters (X_{Fluoro} and Y_{Fluoro}) displayed within the digital mask on the Workstation.

3. Calculate the absolute value of the difference between the film and Workstation X axis values ($X_{Film} – X_{Fluoro} = X_{Diff}$). Verify that the difference recorded is less than 28 mm (3% SID).
4. Calculate the absolute value of the difference between the film and Workstation Y axis values ($Y_{Film} – Y_{Fluoro} = Y_{Diff}$.). Verify that the difference recorded is less than 28 mm (3% SID).
5. Calculate the sum of the values in Steps 3 and 4 ($X_{Diff} + Y_{Diff}$ = Sum). Verify that the sum is less than or equal to 36 mm (4% SID).

MAG2 Field Verification

Record the values measured and calculated for each of the following steps, on the PM Form.

1. Using the film, measure the Normal field exposure X and Y (X_{Film} and Y_{Film}) diameters and record them in the measurement table found at the end of the Beam Alignment Test.
2. Make a Normal mode Fluoro exposure. Using the scale on the beam alignment tool, measure the X and Y diameters (X_{Fluoro} and Y_{Fluoro}) displayed within the digital mask on the Workstation.
3. Calculate the absolute value of the difference between the film and Workstation X axis values ($X_{Film} – X_{Fluoro} = X_{Diff}$). Verify that the difference recorded is less than 28 mm (3% SID).
4. Calculate the absolute value of the difference between the film and Workstation Y axis values ($Y_{Film} – Y_{Fluoro} = Y_{Diff}$.). Verify that the difference recorded is less than 28 mm (3% SID).
5. Calculate the sum of the values in Steps 3 and 4 ($X_{Diff} + Y_{Diff}$ = Sum). Verify that the sum is less than or equal to 36 mm (4% SID).

Pass or Fail

If the measurements recorded for each field size (50 mm x 50 mm, NORM, MAG1 and MAG2) are within the limits specified indicate that the Beam Alignment Test “Passed” on the PM Form. If the measurements recorded for each field size are not within the limits specified indicate “Failed” on the PM Form and perform the Radiographic Beam Alignment procedure found in the Service Manual.

Dose Rate

Entrance exposure is the amount of radiation available at the entrance point of patient anatomy. Entrance exposure is measured 12" (or 30 cm) above the surface of the Image Intensifier in the center of the X-ray beam. This measurement is used to represent the average thickness of patient anatomy. Refer to the 9800 System Service CD ROM for directions on performing the Entrance Exposure calibration.

Dose Rate (MAX. kV & mA)

1. Using a dosimeter for the measurements, record the Actual Dose Rate, max. kV and mA, on the PM Inspection Report form. Limit is < 9.26 R/min.

High Level Fluoro (HLF)

1. Using a dosimeter for the measurements, record the Actual Dose Rate, max. kV, HLF mode, on the PM Inspection Report form. Limit is < 18 R/min.

X-RAY Generator Accuracy Tests (Annual PM)

These tests measure the kVp accuracy of the system.

WARNING: *The following steps produce X-rays. Use appropriate precautions.*

Radiographic Accuracy

Set the system to **FILM** mode. Use a kVp meter. Tolerance (± (5% or 3 kVp) greater of the two)

Radiographic kVp Accuracy @ 50 mas

1. Enter 50 mAs exposure. Take exposures at 60, 90 and 120 kVp and record the results on the PM form.

Radiographic kVp Accuracy @ 200 mas

1. Enter 200 mAs exposure. Take exposures at 60, 90 and 100 kVp and record the results on the PM form.

Fluoroscopic Accuracy

Set the system to **FLUORO MANUAL** mode. Use a kVp meter for the measurements. Tolerance (± (5% or 3 kVp) greater of the two)

Fluoroscopic kVp Accuracy @ 1 mA

1. Enter 1.0 mA beam current. Take exposures at 60, 90 and 120 kVp and record the values on the PM form.

Fluoroscopic kVp Accuracy @ Maximum mA

1. Set the mA technique to the maximum possible setting for each kVp value. Take exposures at 60, 90 and 120 kVp and record the values on the PM form.

Miscellaneous

Dose Area Product Calibration

The DAP Calibration procedure is performed by RUT software. In order for software to accurately calculate the Dose Area Product (DAP) three coefficient values must be determined first. To determine the coefficient values you must measure the dose rate in mR/s for 6 kVp settings (40, 50, 60, 80, 100, 120).

Calculate Coeffecients

1. Remove the Workstation rear cover, exposing VGA and keyboard connector.
2. Connect the cable from the external monitor to the VGA port on the Workstation's rear panel.
3. Plug the external monitor's AC power plug into the nearest AC receptacle and turn on the power to the monitor.
4. Connect the external keyboard to the keyboard connector on the Workstation's rear panel.
5. Connect the RUT serial cable, open RUT, "connect" to the 9800 system and select the Dose Area Product Calibration form.
6. Place the Dosimeter in the center and on top of the II.
7. Set the dosimeter to read the dose rate in R/s. All values should be entered in mR/s.
8. Program the Dosimeter with the current temperature and barometric pressure (some dosimeters have temperature and barometric pressure sensors built in).
9. Select Manual Fluoro mode.
10. Open the collimator iris and leaves completely. You should not be able to see the iris or leaves when you take the exposure. Press the x key on the external keyboard and verify on the external monitor that the iris position is 0 (+1/-10)% closed and the leaves are 0 (+1/-10)% closed.

    ***Note**: Pressing the x key acts as a toggle switch and enables and disables the DAP.*

11. Adjust the technique to 40 kVp @ 5 mA and take an exposure.

    ***Note**: Allow the readings on the dosimeter to stabilize for a few moments.*

12. Read the dose rate on the Dosimeter, divide it by the mA (5 mA) and enter the value calculated into the corresponding dose rate field.
13. Set the kV and mA to each of the following techniques and take an X-ray. Read the Dosimeter for each X-ray shot, divide it by the mA value and enter the value calculated into the Dose Rate field that corresponds to the kV and mA field.
    - 50 kVp @ 5 mA
    - 60 kVp @ 4 mA
    - 80 kVp @ 3 mA
    - 100 kVp @ 2 mA
    - 120 kVp @ 2 mA
14. Once you have entered all six Dosimeter readings press the Calculate Coefficients command button.
15. The A, B, and C coefficients will be calculated and displayed in their respective fields.
16. Click on the File pulldown menu and click on Download DAP Data. This will download the DAP calibration data to the 9800 system.
17. If the system has 1 collimator leaf perform the procedure to Calculate Constants.
18. Archive the DAP calibration data to disk by selecting the File pulldown menu and clicking on Save DAP Calibration File As. Specify the drive letter and path.

Calculate Rotation Calibration Constants

The Dose Area Product (DAP) calculation is affected by the number of collimator leaves. It is only necessary to calculate rotation calibration constants if the collimator has 1 leaf.

Note: *If the number of collimator leaves selected is 2 then the Calculate Constants command button on the Dose Area Product Calibration form will be grayed out and unavailable.*

1. Calculate coefficients prior to performing this procedure.
2. Remove the DAP Paddle Holder's retaining ring, insert the ion chamber and then reinstall the retaining ring.
3. Attach the DAP Paddle Holder to the Collimator cover. The DAP Paddle Holder attaches to the round circular portion of the collimator cover.

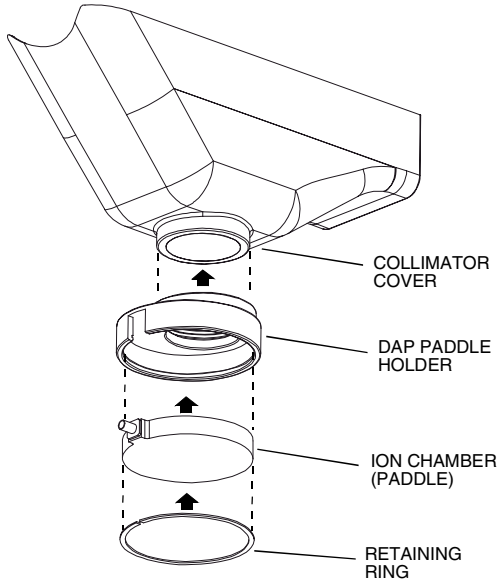

Figure 9. DAP Paddle Holder to the Collimator cover

4. Drive the collimator leaf to the 0° position and verify the position using the external monitor.
5. Open the collimator iris completely and close the leaves completely.
6. Select Manual Fluoro mode and a technique of 80 kVp @ 3.0 mA.

7. Click on the first Iris Pos. number.
8. Click on the Drive Iris To command button, to drive the iris to the position selected. You should not be able to see the iris in the image when an X-ray is taken.

   ***Note**: When you change the iris, leaves, or rotation position take an X-ray shot to update the position information.*

9. Press the x key on the external keyboard to print the current iris position, leaf position and rotation position to the monitor's screen.
10. Press the X key and verify that the iris position printed on the screen measures less than 1% closed, the leaf position is greater than 97.5% closed and the rotation position is 0° ±1°.
11. Take an X-ray exposure.
12. Read the Dosimeter and enter the value in the corresponding Dose Rate at 0 field.
13. Press the Collimator Rotation button on the C-Arm Control Panel and drive the collimator leaf to the 180 degree position. Verify on the external monitor that the position is 180° ±1°.
14. Take an X-ray exposure.
15. Read the Dosimeter and enter the value in the corresponding dose rate at 180 field.

***CAUTION**: Take X-rays at the 0 degree position and then the 180 degree position for each iris setting. Do not drive the collimator leaf to the 0 degree position and take dose readings for each iris position and then drive the collimator leaf to the 180 degree position and take dose readings for each iris position again. Repeatability in iris positioning is not accurate enough to perform the procedure in this manner.*

16. Click on the next Iris Pos. number and then click on the Drive Iris To command button.
17. Drive the collimator leaf to the 0° position and then the 180° position and take an X-ray for each position. Verify that rotation is 0° ±1° and 180° ±1° on the external monitor. Read the value on the Dosimeter for each X-ray exposure and enter the mR/s value in the corresponding Dose Rate at 0° field and Dose Rate at 180° field.

18. Repeat the previous step for the remaining Iris Positions and when you have filled in all of the Dose Rate fields, click on the Calculate Constants command button.
19. After the constants have been calculated click on the File pulldown menu and click on Download DAP data.
20. Archive the DAP calibration data to disk by selecting the File pulldown menu and clicking on Save DAP Calibration File As. Specify the drive letter and path.

Battery Replacement

PCB Batteries

1. Replace the X-ray Controller PCB Battery (Coin type CR2032, 3.0 Volt, Lithium, P/N 74-122905-00).
2. Replace the Workstation Motherboard PCB Battery or PC Card battery (Coin type CR2032, 3.0 Volt, Lithium, P/N 74-122905-00).

   ***Note**: Replace the battery in the Motherboard / PC Card every two years.*

   a. Locate the sticker (P/N 88-359989-00) on the Electronic Card Rack Cover. The sticker will indicate when the battery was last replaced. If a sticker is not present, determine the systems date of manufacture by locating the System Regulatory Label.

   b. If two years has elapsed or will have elapsed before the next scheduled service date, replace the battery and replace the current sticker with a new sticker. Indicate the date that you replaced the battery on the sticker.

FluoroTrak UPS Battery Replacement

1. Remove power to the Workstation by placing the Power switch in the **off** position.
2. Loosen the four knobs securing the cover on the Navigation Computer and remove the cover.
3. Disconnect the battery cable.
4. Loosen the 2 knurled knobs behind the UPS battery and remove the UPS Battery (00-901806) by moving it to the left.
5. Reverse the steps in this procedure to install the new battery.

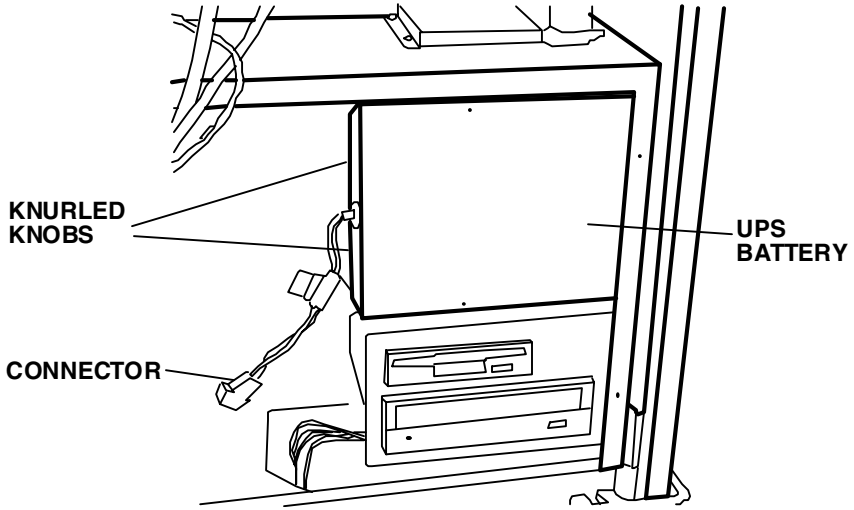

Figure 10. UPS Battery Removal

Completing the PM

Reinstall the Covers

When all necessary steps are complete and access to components beneath the covers is no longer required, reinstall all previously removed covers in reverse order from which they were removed.

1. Position the rear cover so the upper steering shaft can fit into the compression coupler on the lower steering shaft.
2. Position the rear wheels forward, then slide the upper shaft into the coupler to where there is a 1/4-inch to 3/8-inch gap between the ends of the shafts.

CAUTION: *Be sure the wheels are positioned forward (straight) and the set screw heads face directly front when inserted in the couplers before securing the couplers to the shafts. If not installed in this front-aligned position, there is a chance the set screw heads could scrape against the inside of the right front cover when turning the wheels to the right.*

3. Align the steering handle with the rear wheels, then tighten (but do not Loctite) the two upper set screws on the coupler and torque them to 48 in.-lbs. Or, if using a torque screwdriver, torque to 39 in.-lbs. max., then an additional 1/8-inch turn with an allen wrench.
4. Reinstall the C-Arm rear cover, top front cover, left front cover, right front cover, and front leg cover. Refer to the Torx Crestcup Torque Specifications for the correct amount of torque to apply when reinstalling the covers.

Torx Screw Size	Nominal Torque value	Acceptable Range
4-40	6 lbs./in	5-8 lbs./in
6-32	15 lbs./in	13-16 lbs./in
8-32	22 lbs./in	21-24 lbs./in
10-32	30 lbs./in	28-31 lbs./in

Test the Steering

1. With the C-Arm's wheel brake engaged, turn the right steering handle 90° to the left and right. Verify that the wheels move 90° to the left and right.
2. Place the C-Arm's wheel brake in the neutral (flat) position. Push the C-Arm slowly and verify that when the steering handle is turned the C-Arm turns.
3. Place the Workstation's wheel pedal completely up. Push the Workstation and verify that the casters lock in place and the wheels roll in a straight line.
4. Place the Workstation's wheel pedal in the center position. Push the Workstation and verify that the wheels and casters turn freely.

Power ON

1. Apply Power to the system and verify that the Workstation and C-Arm complete the boot sequence and are functional.

PM Form Printing

To complete the PM Form perform the following:

1. Save the PM Form to your hard disk using the serial number of the 9800 system if you have not already done so.
2. Print the Form and sign it.
3. Obtain the customer's signature.
4. Make two photocopies of the PM Form.
5. Mail the copy with the original signature to GE OEC Medical Systems, Inc.
6. Leave a copy with the customer.
7. Keep one copy for your records.